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ABSTRACT

The work reported in this paper focused on the creation of an Internet-based resource for preservice and inservice teachers. A World Wide Web-based instructional resource was developed by a participatory team comprised of subject area and instructional design experts as well as potential users including preservice and inservice teachers. The Constructivist Educator's Page is a Web page which includes three general types of material: a database of information and resources, an area for discussion, and a collaborative project area. The design model used was based on three guiding concepts: participatory design, recursive or iterative design, and reflection. The definition focus included front-end analysis that investigated whether there is a need for the type of alternative instructional material, the creation of a participatory team that includes both experts and potential users, and establishment of a progressive problem-solution focus. The design and development processes were combined into one focus. Preparation tasks included selection of a development environment, selection of instructional media, and selection of the format and instructional strategies. The creation tasks category includes the procedures for developing the product. Based on the comments of experts and end users, the Constructivist Educator's Page appears to have several advantages over traditional instructional models. (AEF)

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A Web-Based Instructional Resource for Teacher Education: Constructivist Approach

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A Web-based Instructional Resource for Teacher Education: Constructivist Approach

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Over the past ten years, there has been dramatically increasing interest in the use of technology to support student-centered/constructivist learning. However, in spite of the great benefits of technology for constructivist learning, the majority of teachers have little or no experience using technology in the classroom. That applies to constructivist as well as more traditional uses of technology. The problem appears to begin with the preparation teachers receive in their preservice programs. A number of recent studies and reports in the area of technology and teacher education (Willis & Mehlinger, 1996; OTA, 1995; Thompson & Schmidt, 1994) have indicated that preservice teacher education has failed to prepare teachers adequately. Even the teaching materials used in preservice teacher education have been questioned. Several reviews of instructional materials used for computing courses in teacher education programs have indicated that the content or structure of textbooks or instructional packages is inadequate (Padron, 1992). In fact, the lack of well designed, appropriate instructional materials that support the integration of technology into teacher education may be one of the major barriers to wider, more effective integration.

Writing a "better" textbook on the constructive use of technology is one way to address the problem of instructional resources. Another way would be to take advantage of the available technology and create an electronic resource. The work reported here focused on the creation of an Internet-based resource for preservice and inservice teachers. In this study a web-based instructional resource was developed by a participatory team comprised of subject area and instructional design experts as well as potential users including preservice and inservice teachers. The Recursive, Reflective, Design, and Development (R2D2) instructional design model developed by Willis (1995) guided the design and development process.

Product Overview

The Constructivist Educator's Page is a web page temporarily located at http://www.cite.uh.edu/seung/frame.html. It includes three general types of material: a database of information and resources, an area for discussion, and a collaborative project area. The entire site, including the home page, uses two different frames: a small left frame for main buttons which can be clicked to jump wherever the user wants to go in the site and a larger right frame that displays material selected by the users (see Figure 1). The database area, which is the largest area on the site, includes four units: i) constructivist learning theory, ii) lesson ideas, iii) cases, and iv) references. The discussion area allows users to select a thread by clicking a topic in the content frame. The project area provides annotated links to some ongoing projects as well as centers around the world where constructivist teaching is a major focus. Each area in the site contains a different type of information about constructivist teaching and learning. This web site is open to everyone who has access to the Internet.

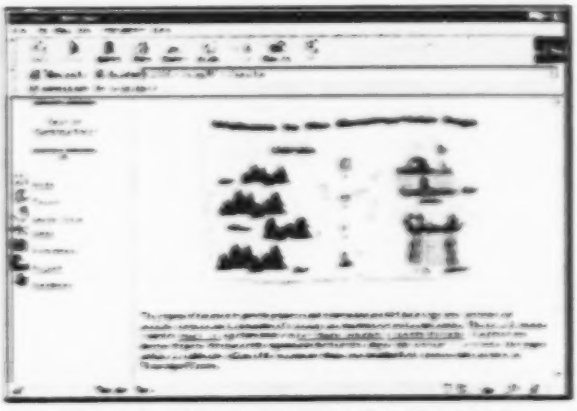

Figure 1. Home page on Constructivist Teaching

The Design and Development Process

The instructional design model used in this study, R2D2, is based on three guiding concepts: participatory

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design, recursive or iterative design, and reflection. Each of these foundational concepts supports the idea of gradually shaping a vague idea into a more precise and more fully formed product. The entire design and development process was iterative and occurred in a non-linear fashion. There was no linear set of steps, but it does include two focal points: a) the definition focus, and b) the design and development focus.

The Definition Focus

The definition focus included 1) front-end analysis that investigates whether there is a need for the type of alternative instructional material, 2) the creation of a participatory team that includes both experts and potential users, and 3) establishment of a progressive problem-solution focus that begins with a vague idea of what is to be developed and progresses through more and more detailed and complete versions of the material.

Front-end Analysis. The front-end analysis was conducted via a review of the literature on technology and teacher education programs, interviews with teacher educators and teacher education students, and observations of courses about technology in teacher education programs. Through the front-end analysis, several problems in technology and teacher education programs were identified: 1) Instructional strategies in teacher education programs are heavily based on behaviorist approaches. 2) Preservice teacher education students do not see modeled, or learn to use, a wide range of instructional strategies that support incorporating technology into classroom teaching. 3) While teacher educators and preservice teacher education students have positive attitudes toward constructivist approaches, instructional materials based on constructivist approach are not widely available. These findings formed part of the basis for creating the prototype of the instructional material developed in this study.

Creation of the Participatory Team. In this study the development team consisted of several teacher educators who teach methods courses for preservice teacher education students, educators who are knowledgeable about constructivist uses of technology, instructional design specialists, and instructors and students in preservice and inservice educational computing courses. The members of the development team helped develop the concept for the instructional resource, participated in the development of the prototype, and provided input and feedback on everything from instructional goals and topics to be covered to instructional strategies and user interface.

Progressive Problem-Solving Focus. In the R2D2 instructional development model both the problem and the solution are progressively defined throughout the interaction of the development team members. This study used several techniques such as semi-structured interviews, individual and small group tryouts, observations, and open-ended questionnaires to encourage participation in the development process. Subgroups of the team also occasionally met together to discuss the current status of the project and make decisions about changes.

The Design and Development Focus

The design and development processes were combined into one focus instead of separating design from development and requiring a linear "design first" "then develop" sequence. That is, members of the team worked on components of, and versions of, the package and made changes continuously. Some ideas were selected and developed across the process, but some were initially selected but later abandoned as the team elected to take the development in a different direction.

Preparation Tasks. The preparation tasks included a) selection of a development environment, b) selection of the instructional media, and c) selection of the format and instructional strategies. The preparation tasks were performed by discussion with experts and examination of contexts in teacher education programs.

a) Selection of a Development Environment - The development environment for this project includes a number of different software products such as Adobe PhotoShop, Microsoft Image Composer, and PowerPoint but was centered on the creation of a multimedia/hypermedia Web document. Most pages in the site were created in Microsoft FrontPage and modified by hand coding.

b) Media Selection - The medium of instruction was interactive, Internet-based, hypermedia using World Wide Web (WWW) technology. The WWW is a powerful navigational tool, providing access to virtually limitless Internet resources. The instructional material developed on the Center for Information Technology in Education (CITE) server at the University of Houston was delivered via the Internet.

c) Format and Instructional Strategies Selection - The material developed in the study was created in a number of different formats, such as hypertext documents, instead of a traditional textbook format. Different units had different formats, called for different types of interaction on the part of students, and supported different types content. For example, the discussion area supported a range of communication alternatives. These alternatives included threaded discussion groups where topics can be raised by any participant (see Figure 2).

Creation Tasks. The creation tasks category includes the procedures for developing the product. These procedures of design and development were divided into five major types: a) beginning concepts and ideas, b) component development, c) single path prototype, d) alpha version, and e) beta version. Progress through these creation tasks was not, however, strictly linear. Some component creation was the beginning point, but components were revised, changed, or redone throughout the

process as the participatory team worked on improving the product. Throughout the process, feedback and participation from both experts and potential end users provided information used by the designer to make changes and revisions to the product.

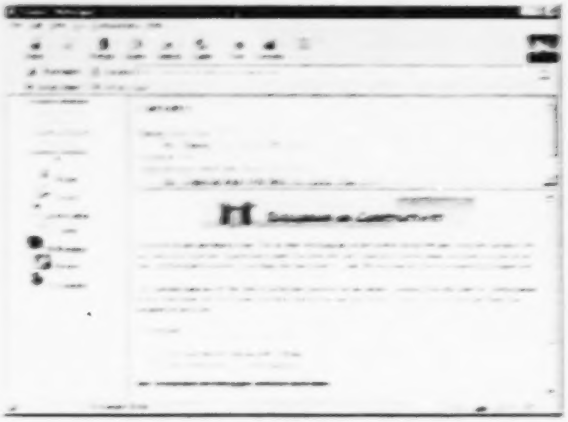

Figure 2. Interactive Discussion Area.

a) Beginning Concepts and Ideas - The beginning work started with the general idea of developing a web site that was an organized, but non-linear information resource on constructivist learning environments. Some of this content would be original, created specifically for the site, and some would be available via links to other sites. The conceptual outline of this web site was developed through semi-structured interviews with stakeholders like the instructor who had suggested the creation of this project. Interviews with four stakeholders were conducted to identify the needs of users. They suggested that effective materials for teacher education are needed to provide more information about instructional strategies based on constructivist approaches and various uses of technology in constructivist learning environments.

b) Creation of Components - During the design and developement process for individual components, the home page was much more carefully developed than many other pages because the components of other pages in the site depended on the home page. After the home page was developed, a graphic design expert suggested that a consistent, integrative design relating the major units of the web site to the icons on the home page would help users identify their position while navigating the information resources. Most titles on the site were created in tones of green or yellow to make them consistent with the "Forest" icons that were used as a metaphor of the site's information landscape home page. In addition, one important goal of the design and development process was the creation of a user-friendly interface that would make it easy for novice teachers to navigate the web site.

c) Single Path Prototype - A single path prototype is a limited version of the product that allows users to explore all major aspects of the package if they "stay on one path." The purpose of creating a single path prototype was to obtain feedback or suggestions about all aspects of a working model before the development team created a version of the entire program. Eight stakeholders, two graduate students in instructional technology, three undergraduate students in teacher education, and three experts in instructional technology and constructivist learning theory, were involved in the evaluation of the single path prototype. This single path prototype was revised many times.

There were several major recommendations about the single path prototype from experts and students. For example, the theory unit was well organized with the emphasis on constructivist theory related to classroom teaching and some of the more esoteric links to constructivist philosophy were eliminated. In addition, all the links to other web sites were annotated with a brief explanation of the link (see Figure 3).

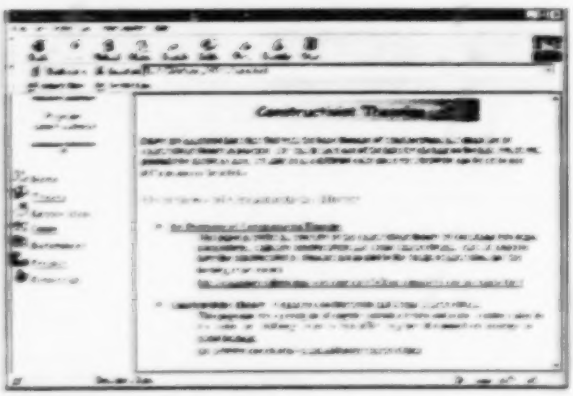

Figure 3. Constructivist Learning Theory Page in a Revision.

Experts and students who worked through the single path prototype were very positive about the site. According to them, the graphics were attractive and the layout was very clean and consistent. Also, they felt the content on the web site helped teachers understand constructivist theory and teaching.

d) Alpha Versions - When revisions in the single path prototype warranted no more significant changes, the alpha version, a full rough version of the product, was developed. The alpha version included all paths and options in the three areas of the site: database, discussion, and project. All components in the product were essentially functional though some areas still had rough graphics and tentative content. The alpha version was evaluated by experts and potential end-users including novice users who were not familiar with the content or web technology.

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Three subject matter experts and five preservice teacher education students explored and evaluated all areas of the Constructivist Educator's Page. They were generally very positive about the overall content, data structure and user interface. Experts also made many suggestions about other resources that could be added to the site, including links to other web sites that described constructivist projects. Expert comments resulted in two major changes to the alpha version. The first major change was related to the content included in the lesson ideas area. In a revision several additional types of instructional strategies/learning environments were added including information banks, symbol pads, construction kits, phenomenaria, task managers, and microworlds (see Figure 4).

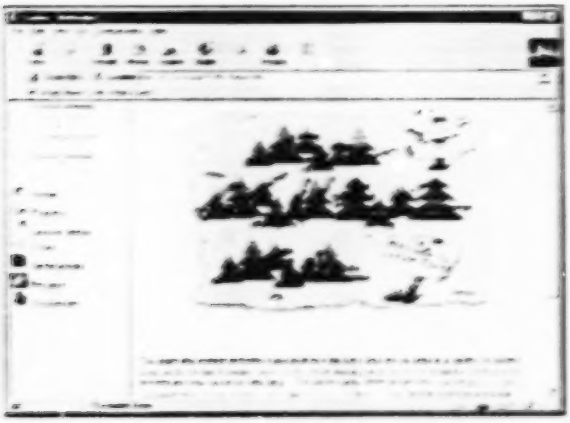

Figure 4. Lesson Ideas Area in the Alpha Version.

The second major revision was also related to paths through the database. One constructivist teacher educator suggested that instructional strategies and learning environments might be combined in one path and that another path for exploring lesson ideas by grade level should be added. Therefore the lesson ideas area (see Figure 4) was divided into three different paths: grade levels, learning environments or instructional strategies, and subject areas. A number of students who evaluated the alpha version also contributed lesson plans or ideas of their own. For example, the lesson idea called the Best Building was contributed by a student who was a second grade teacher in a bilingual classroom.

e) Beta Versions – When suggestions for revisions to the alpha version were made, the resulting the beta version was uploaded to the Center for Information Technology in Education (CITE) server at the University of Houston and was delivered via the Internet. Until that point components and versions of the material had been run locally from a Zip disk or hard drive. Users could access the Constructivist Educator's Page at http://www.cite.uh.edu/seung/frame.html. All components in the beta version were fully functional and all graphic design components were finished (tentatively). The beta version was evaluated by eight potential end-users through a survey questionnaire, by observations of use, and by informal interviews while students were using the product. Most evaluators felt the Constructivist Educator's Page was interesting and motivating. They liked the screen design including the use of color and text, and they found the navigation options easy to use and functional. They could navigate without any difficulty in the database area and project area.

There were a few suggestions for changes or revisions. For example, some users wanted to see more examples in their particular areas. Another comment was about background color. Two users suggested using a different, distinctive background color for each page, but this suggestion was not implemented. When asked, several other students said they did not want the color or background graphics to change from page to page because of additional time required to navigate the site. When all the revisions to the beta version were made, the product was considered to be Version 1.0. The Constructivist Educator's Page was then ready for general use in preservice and inservice teacher education.

Discussion and Conclusions

This study was a development project that used an alternative instructional methodology. While traditional studies emphasize objective methods of data collection, this study depended on subjective data obtained via interviews, discussions, observations, and questionnaires. The design and development work was performed in a flexible, iterative format that encouraged input from a range of stakeholders. Most decisions were made through negotiation among members in the collaborative group. Across the design and development process there were hundreds of revisions, some large, some small, but all a result of input from experts or end users.

Based on the comments of experts and end users, the Constructivist Educator's Page seems to have several advantages over traditional instructional materials. One of the advantages is that it supports a user-centered learning environment through a non-linear information landscape. Second, the web site is not a static entity. This web site can be a dynamic, changing entity in ways that are simply not possible with traditional printed material. Third, the Constructivist Educator's Page provides preservice and inservice teachers with not only a variety of lesson ideas but also accessible information on the basic concepts of constructivist learning theory. The Constructivist Educator's Page includes practical and useful resources relevant to constructivist teaching on one web site as well as links to many other useful sites. Fourth, with Internet connectivity, the Constructivist Educator's Page can be

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accessed from anywhere there is an Internet connection by anyone who has access to relatively basic computer equipment, an Internet connection, and suitable browser software. There is no additional cost to access the resource. At the end of study, the Constructivist Educator's Page was judged by experts and potential end-users to be a valuable and useful site for educators seeking information on both the theories of constructivism and the practical professional implications of the theory. However, this ongoing project will be expanded and revised continuously through the active participation of preservice and inservice teachers.

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